

## FRESHWATER ECOLOGY

# A river runs through it

A meandering history probes the Colorado River's verdant legacy and fraught future

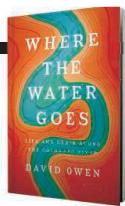
By Kevin C. Rose

**W**here the Water Goes traces the flow of the Colorado River from its headwaters in the Colorado Rocky Mountains to its terminus at the Gulf of California in Mexico. Part road-trip documentary, part memoir, and part geopolitical and hydrology lesson, author David Owen's book follows the historical and geographic course of the river, the water it carries, and the lives that depend on it.

The plight of the Colorado is emblematic of a struggle that many regions around the world face as overuse and environmental degradation threaten both the quantity and quality of available fresh water. In length and flow, the river is relatively small, but it crosses many political boundaries where water is scarce and tensions can run high. The Colorado provides water to nearly 40 million people across seven states and two countries, supports some of the largest urban areas and some of the most productive agricultural fields, and enables industries that make up more than a quarter of the U.S. economy.

While many water-rich regions are governed by the idea that water rights and access must be shared equitably by all adjacent property owners, the doctrine of "prior appropriation" applies to the Colorado River. Prior appropriation can be summed

**Where the Water Goes**  
Life and Death Along the Colorado River  
David Owen  
Riverhead Books, 2017. 288 pp.



up as "first in time, first in right." The doctrine effectively converted the Colorado's water into private property.

An important implication of prior appropriation is that in times of scarcity, sacrifices are made by the most recent claims, rather than shortages being shared by all stakeholders. This explains why, for example, citizens of New Mexico and Arizona must cut back on water consumption before Californians. Relatively recent ideas, like conserving water to maintain a river's ecology, are often low on the priority list, as are other ecosystem services beyond water supply, such as fisheries or recreation.

It would be easy for Owen to point the finger of blame for contemporary water shortages and quality degradation at past decades of mismanagement, ignorance, and hubris, but the reality is complex and nuanced. He effectively describes the links between historic precedents, choices, and events that led the river and the millions of people who depend upon it to the present state.

Despite the fact that the winter of 2016–2017 may end up being the wettest in the Colorado River basin in the past 20 years, water shortages and quality degradation remain critical issues for the region. Every drop of water in the Colorado—and then

some—has been allocated in some form.

When the Colorado River Compact was ratified in 1922, hydrologists estimated that the Colorado's annual flow was at least 17 million acre-feet ( $2.1 \times 10^{10} \text{ m}^3$ ). It was not until decades later that we discovered that the early 20th century was one of the wettest periods in the past 500 years, meaning that the initial studies substantially overestimated the river's normal flow. Water withdrawals now run a deficit of 1.2 million acre-feet ( $1.5 \times 10^9 \text{ m}^3$ ) per year. This constraint is being widely felt through water use restrictions and dropping reservoir levels.

The "paradox of efficiency" is a theme that emerges throughout *Where the Water Goes*. Although improved efficiency of use may reduce the water deficit and increase reservoir levels, it can have the unintended consequence of increasing consumption rates because of increasing demand (also called the Jevons paradox). It may also be detrimental to the Colorado's unique ecology. In areas where irrigation practices have improved, for example, less runoff is lost to shallow groundwater, thereby reducing water that would once have flowed into surrounding streams and wetlands.

*Where the Water Goes* barely mentions climate change, but climate effects are already altering the river. Between 2000 and 2014, the river registered its worst 15-year drought on record, with flow averaging 19% below the long-term mean. One-third of this reduction in flow has been attributed to climate change, and climate projections indicate deteriorating conditions in future decades (1). Whatever the future holds, the Colorado River is deeply intertwined with other environmental problems and cannot be addressed in isolation. ■

## REFERENCE

1. B. Udall, J. Overpeck, *Water Resour. Res.* **53**, 10.1002/2016WR019638 (2017).

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